Photo Manual for Fisheries Air Patrols

The Use of Cameras to support Fisheries Aerial Surveillance

FFA

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This manual has been developed by the **Pacific Islands Forum Fisheries Agency** (FFA) and **Trygg Mat Tracking** (TMT), to support Air Patrols in the Pacific region. It is complementary to and supports the FFA/PMSP Aerial Surveillance Standard Operating Procedures (SOPs).

However, the processes are highly relevant to all countries and regions utilizing air patrols to support fisheries MCS, and broader use of the manual is encouraged. While this manual serves as a stand-alone tool, it has been developed as a companion document to the 'Photo Manual for Fisheries Enforcement – the use of cameras in fisheries operations' previously developed by TMT and Stop Illegal Fishing.

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Foreword

This manual covers photography as a supporting function of fisheries air patrol inspections. Many of the general points covered in the first chapter apply to photography in general and may be equally useful to fishery inspectors using cameras as a tool for evidence collection during sea-borne or land patrols.

The manual is intended to support evidence collection efforts in fisheries law enforcement, with a focus on photography and the understanding and the skills needed to handle camera equipment confidently. The aim is to foster the ability of inspectors to consistently snap photographs that can fulfil their purpose.

Photographs taken from patrol aircraft can have several purposes. Two key uses are to assist in the visual identification of fishing vessels when remote identification through AIS, VMS or radar is not possible, and to collect evidence of illegal activities and operations in support of legal proceedings.

Since the advent of mobile phones equipped with photo camera functions, photography has come into reach of a very wide cross-section of the population.

As a result many people today have a better sense of how to snap a picture – and how to avoid common pitfalls messing up shots – but it can leave people with a false sense of knowing enough about photography to do a professional photographer's job.

The world of fishery law enforcement abounds with shockingly poor photographs snapped from aircraft, that – even though shot from a distance of a hundred meters or less – have led to material that was insufficient to identify the vessel, much less able to be used in a court of law as evidence to support a prosecution. This manual sets out to minimize those instances, ensuring that money invested in air patrols is not wasted on substandard camera handling skills resulting in poor photos.

Photography by itself – and with it the pursuit to ensure consistent and reliable outputs in the domain of air patrol photography – is a complex matter that requires time and dedication in order to confidently master all of the important aspects.

Skills required of inspectors snapping photos in an air patrol setting include the following:

1. technical understanding of the photo equipment and process of taking pictures;
2. situational awareness – so that adjustments to the camera made in fluid situations result in picture optimization;
3. attention to detail – ensuring that elements that truly matter are captured;
4. second-nature camera handling skills – so that adjustments to the camera can be made quickly and confidently.

It is hoped that this manual will both stimulate photo inspectors to hone their critically important photography skills, providing basic knowledge and guidance, and that in time, its implementation will result in the production of high quality fishery air patrol photography in the WCPO.

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Glossary

APERTURE - The aperture on the camera is a hole that controls how much light flows through the lens to fall on the sensor. The aperture not only affects the brightness (or exposure) of the image, but the depth of field also. The aperture setting is identified by an f-number, often called an f-stop (a ratio comparing the focal length to the effective aperture diameter). The lower the f-number, the more light will come through the lens (smaller number = wider aperture), and vice-versa.

APERTURE PRIORITY (AV) - Aperture priority, often abbreviated A or Av (for aperture value) on a camera mode dial, is a setting on some cameras that allows the user to set a specific aperture value (f-number) while the camera selects a shutter speed to match it that will result in proper exposure based on the lighting conditions.

BLUR - A characteristic of photos that lack in sharpness, and on which things are difficult to identify. Blur can be caused by two things:
a) defocus aberration, blurring an image due to incorrect focus, and
b) motion, blurring an image due to movement of either the subject and/or the camera.

CONTRAST - The difference in colour and light between parts of an image.

DSLR - Single-lens reflex camera with a digital imaging sensor.

EXPOSURE - The amount of light per unit area reaching the electronic image sensor, as determined by shutter speed, lens aperture, and scene luminance. In photographic jargon, “an exposure” is a single shutter cycle.

FOCUS - The point toward which light rays are made to converge. In photography, focus is about obtaining sharpness of the subject and being able to clearly see and recognize what we are looking at.

GLARE - Glare occurs when too much light enters the camera and interferes with its ability to meter and guide exposure properly – generally resulting in under-exposed photos. Glare is caused when a source of light hits a reflective surface.

ISO - In digital photography, ISO measures the light sensitivity of the image sensor. The lower the ISO number, the less sensitive your camera is to light and the finer the grain of the resulting photos – meaning higher quality.

LENS - A lens is an optical tool used in combination with a camera body to bring light to a fixed focal point. In a DSLR, the lens directs and focuses light onto a digital sensor.

LIGHT - Light or visible light is electromagnetic radiation within the portion of the electromagnetic spectrum that can be perceived by the human eye.

METADATA - These are non-photo (i.e. non-pixel) data contained in a photo file. They cover camera sensor data which are required to interpret the sensor image data, including the size of the sensor, and its colour profile. They also cover image attribute data which include exposure settings, camera/lens model, date (and, optionally, place) of shoot, etc. authoring information and other. Some raw files contain a standardized metadata section with data in Exif format.

METERING - Metering is how the camera determines what the correct shutter speed and aperture should be, depending on the amount of light that goes into the camera and the ISO. DSLRs have an integrated light meter that automatically measures incumbent light and determines the optimal exposure, on the basis of the selected metering mode.

PHOTO - A picture produced by photography

PIXEL - A pixel, pel, or picture element is a physical point in a raster image, or the smallest controllable element of a picture represented on the screen. Each pixel is a sample of an original image.

POST-PROCESSING - Post-processing in photography is a process of editing the photo data captured by the camera to enhance the image. The better the data captured during shooting, the better the enhancement possibilities. There are various post-processing techniques that can be applied, based on what is to be achieved.

IMAGE SENSOR - A sensor that detects and conveys information used to make an image. It does so by converting the variable attenuation of light waves into small bursts of current that convey the information.

SHOOT / SHOT - The physical action of taking a photo / photograph

SHUTTER - Device through which the lens aperture of a camera is opened to admit light and expose the electronic image sensor. An adjustable shutter controls exposure time, or the length of time during which light is admitted.

SHUTTER PRIORITY (TV) - Shutter priority (usually denoted as S or Tv on the mode dial), also called time value, refers to a camera setting where the user chooses a specific shutter speed while the camera adjusts the aperture to ensure correct exposure.

STORAGE MEDIA - The removable electronic storage device, generally in the form of a small “card”, that is placed in the camera, and which records and stores photos in real-time. All storage media have a nominal capacity, which invariably determines the maximum number of photos they can store at a given resolution.

SUBJECT - The subject is the object that is shown in the photo. A single photograph can show several things. The subject is the focus of the image, both literally as the sharpest point in the photograph and in terms of point of interest.

SHARPNESS - Refers to a photo’s overall clarity in terms of focus and contrast. When the subject is sharp, the image appears clear and lifelike, with detail, contrast and texture rendered in high detail. It is the opposite of “blurred”.

1.1 Photo Equipment

DSLR Cameras

This manual is written from the perspective of using a DSLR camera during daylight hours. “DSLR” stands for “single-lens reflex camera with a digital imaging sensor”. These cameras allow the photographer to look through the lens, and the photos are stored on digital media (e.g. SD card).

DSLR cameras are hand-held and are used by the inspector by pointing them out of a window or the photo bubble fitted on a patrol aircraft. DSLR cameras accept different lenses ranging from wide-angle to tele-lenses, implying that a mounted camera consists of the camera body and the fitted lens – two separate elements, which are attached to one another through a “mount”. DSLRs are the preferred photo camera type for fishery air patrol photography work.

Figure 1. DSLR camera fitted with a wide angle to tele zoom lens (18-300mm), with lens hood mounted and lens cap in foreground © Gilles Hosch/ Trygg Mat Tracking

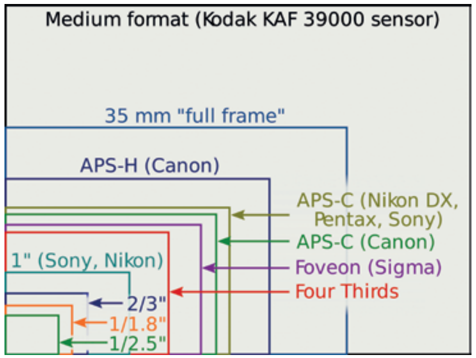


Figure 2. Relative sizes of different electronic camera image sensors. Source: https://en.wikipedia.org/wiki/Image_sensor_format

Other cameras

Other cameras include more compact models with electronic viewfinders, of which the degree of customization may be limited. The image sensor of these cameras is often smaller than that available in DSLR cameras, limiting their resolution – and are not ideal for this type of work.

APS-C and full-frame format cameras

The image sensor of a DSLR “captures” each photo, and the sensor type determines the maximum resolution of the photos that can be snapped with any given camera. DSLR cameras are generally fitted with one of two possible image sensors – an APS-C format sensor, or a full-frame format sensor. It is best to opt for a full-frame sensor camera, which provides 2.5 times more pixels per photo than an APS-C format camera. Modern full-frame cameras produce photographs consisting of >30 million individual pixels.

In cases where an APS-C format camera has already been acquired, awareness of the implications is key.

Figure 3. Examples of three zoom lenses (from left to right); 1) TAMRON 70-300mm tele zoom lens; 2) CANON 24-105mm wide to intermediate range zoom lens; 3) CANON 10-22mm ultra wide angle zoom lens © Gilles Hosch/ Trygg Mat Tracking

Lenses

DSLRs accept a wide range of lenses of fixed or variable focal length.

A lens with a fixed focal length cannot zoom in or out of a scene, and the framing is conditioned entirely by the distance of the aircraft to the object of interest. This type of lens is not ideal for air patrol photography – while they may be very interesting for land-based photography missions.

A lens with a variable focal length is called a zoom lens. By pulling (or twisting) a ring on its housing, it allows it “to get nearer to”, or “to move further away” from an object, without changing the position of the photographer. These lenses are a great choice for air patrol photography, as they provide much needed flexibility to frame pictures well.

The ideal lens combination for air patrol is a combination of two lenses, of which the first one covers the focal length range of 20-70mm (wide angle), and the second the 70-300mm (tele).

Lenses should always be of the auto-focus enabled type. If they have an in-built image stabilizer – a highly desirable feature for use on patrols – it should be switched on at all times.

Lens protection

The lens is the eye of the camera. Its pristine condition is paramount for the quality of the pictures.

Two elements stand out. The first is the lens cap, which must be attached to the front-end of the lens at all times when the camera is not in use. There is no reason to ever disregard this rule. Made of hard plastic, the lens cap creates a physical barrier between the lens and any hard object that could scratch and damage its surface.

The second element is a filter that can be screwed onto the lens. Every lens has a set diameter (indicated on its leading edge) and a thread that accepts filters to be screwed onto it. A so-called “UV filter” is optically neutral and serves the purpose to function as a sacrificial element in case a sharp object is pushed into the lens. Filters typically cost 30 to 50 times less than a lens and can easily be replaced.

Figure 4. Lens fitted with a 62mm UV filter for protection © Gilles Hosch/ Trygg Mat Tracking

Figure 5. Tele zoom lens fitted with a hood. © Gilles Hosch/Trygg Mat Tracking

Lens hoods

The main purpose of a hood is to block or reduce the amount of lens flare and lens glare in photos by acting like a visor for the lens. Flare and glare are types of reflected and scattered light that hit the lens from an angle. This is more likely to happen when shooting from the bubble, than when shooting through a window.

Lens flares can destroy the value of photos by covering the subject or most of the scene, while hoods add contrast to photos. Therefore, the use of a lens hood is always recommended – especially in sunny conditions. Depending on the size of the hood (hoods of zoom lenses can be exceedingly long), and the constellation of the aircraft, a hood may become impractical and has to be detached. Care has to be taken in such cases that lateral direct light hitting the unprotected lens is minimised.

Figure 6. Examples of memory cards (from left to right); 1) 32GB Micro SD card; 2) SD card-sized adapter for Micro SD card, to insert and copy files onto PC – SD memory cards of the exact same size also exist; 3) 16GB CompactFlash (CF) card © Gilles Hosch/Trygg Mat Tracking

Storage media

Storage media type is pre-determined by the brand and type of DSLR in use. SD Card-type media are common. They store the photographs and sit inside the camera body.

Two important considerations regarding storage media: a) ability to store lots of photos, and not to need frequent replacing, and b) they need to be fast – meaning the ability to store an instantaneous and important flux of photo data coming from the sensor in a very short period of time. Slow media can cause “data traffic jams” in the camera, times during which the camera is unable to shoot and process new photos.

A good option is to opt for storage media of 64Gb in capacity – and more if available.

Bags

A camera should always (!) be carried to and from the aircraft in a dedicated, padded, professional camera bag. Camera bags come in many shapes and sizes. Their primary function is to protect the equipment.

1.2 Photography - key considerations

Light and glare

The word photography literally means “to write with light”. A photograph is at its most basic a snapshot of the light emitted by, or bounced off an object of interest – it is not a snapshot of the object itself. Absence of light entails absence of photography.

Presence of light means the basic ingredient to produce a photograph is given, but you must work with the light, not against the light. With the light in the back, it illuminates the photographer’s object of inquiry, and the object bounces the light back at the camera. This is the ideal situation.

With the light source ahead – and behind the object of enquiry – the camera will be blinded by the glare, just like the human eye. At sea this is often amplified by additional glare from sunlight hitting the surface of the sea. The more the light source and the object are lined up ahead of the photographer, the poorer the quality and usefulness of the resulting photo. The camera’s ability to determine an appropriate aperture/exposure setting (called “metering”) under these conditions is impaired.

Figure 7. The glare of the sun (which is directly behind the vessel in this image) has resulted in glare and a poor-quality image that is not usable. ©Greenpeace

Photo file format - RAW

Digital photographs can be saved in several different file formats by the camera. Of the available formats, RAW is the most detailed and appropriate to use. It contains the largest possible amount of data. The camera setting for file format should therefore always be set to RAW, and at the highest resolution (if there is a choice).

ISO

ISO stands for the camera’s sensitivity to light. It typically ranges from 50 (low sensitivity) to several 1000s (high sensitivity). When shooting in low light conditions, the sensitivity must be ramped up, while it can be maintained at a very low setting in very bright conditions.

The ISO setting predetermines how much light (aperture) and how much time (shutter speed) are needed to shoot a given picture. And those settings – in turn – will also determine certain elements of the resulting photo’s quality.

As a rule of thumb, it is useful to keep the camera set at 400 ISO in bright light conditions, and to dial it up to 2000 ISO on overcast days, or otherwise lower light conditions. Higher ISO settings cause more noise in the photograph. However, modern day high-end DSLRs suffer little picture quality loss across the above indicated range.

A good option is to set the camera on auto-ISO – where the camera will opt for the best ISO option under ambient conditions and related settings.

White balance

White balance (WB) in digital photography means adjusting colours so that the image looks natural. The process of adjusting colours is to match the picture with what the inspector saw when she/he took the photograph. Most light sources (the sun, light bulbs, flashlights, etc.) do not emit purely white colour and have a certain “colour temperature“. The human brain processes information coming from our eyes, automatically adjusting the colour temperature, so we see colours correctly automatically.

A good option is to set the camera on auto-WB. The camera selects the appropriate WB under prevailing light conditions.

Aperture, sharpness and depth of field

Aperture is all about the amount of light we allow to enter the lens when a picture is taken, and it is useful to think of aperture as a tap, and the photo taken as a bucket that needs filling to the brim. If we open the tap widely (a wide aperture), water flows quickly, and the bucket fills quickly. If we open it slowly (a narrow aperture), then we need more time to fill the bucket.

The time needed to fill the bucket is equivalent to the shutter-speed. Aperture and shutter-speed always work hand in hand. A wider aperture leads to a faster shutter speed, and vice versa. In the same analogy, it is useful to think of ISO as the size of the bucket: low ISO setting, very big bucket; high ISO setting, very small bucket.

Aperture determines sharpness and depth of field of the resulting photograph. Wide apertures lead to more scatter inside the lens and tend to produce softer contours and outlines of objects. Also – and rather importantly – wider apertures lead to loss of focus in the foreground and the background. With a very wide aperture, we get focus on the object of immediate enquiry only, while things positioned closer or further away from this object, move out of focus with increasing distance (with regards to the position and axis of the lens). However, wide apertures have the advantage that they work with faster shutter speeds – so we need “less light”.

Narrow apertures provide sharper photos, and provide good depth of field. Objects have sharper contours, and remain in focus in front of, and behind the object on which the camera has focused. The disadvantage of the narrow aperture is that less light penetrates, and that it requires relatively slower shutter speeds – we need “more light” to work with narrower apertures.

A good option is to set the camera on auto-aperture – where the camera will automatically determine the best aperture under ambient conditions and related auto- or manual settings (i.e. ISO and shutter speed).

Shutter speed, and the freezing of motion

Shutter speed denotes the length of time the shutter in the camera’s body opens up to let light fall onto the sensor, snapping the photo. In hand-held photography, shutter speeds invariably are minute fractions of a second.

Since air patrol photography occurs in an environment of moving platforms (both the aircraft and the fishing vessel), shutter speed is the most important consideration – and the most important camera setting. Shutter speed ought thus be set and controlled manually.

The characteristic of photos shot with faster shutter speeds is sharpness – the opposite of blur. Very fast shutter speeds manage to freeze the motion of objects in movement, and to render moving objects perfectly immobile. Detail is maximized, blur is minimized, and everything can be made out.

The go-to option for air patrols is to fix the shutter setting manually at a minimum of 1/200 sec – and let the camera adjust aperture and ISO automatically. This mode is set using the “mode dial” and is generally denominated “Tv”. Note that you can opt between auto-aperture (Tv) or auto-shutter speed (Av) pre-set modes, and that both are mutually exclusive. Since motion is the factor that needs mitigation, it is shutter speed you want to set manually. This mode (Tv) is generally referred to as “shutter priority mode”.

Wide angle and tele shots – motion blur

The relationship between motion blur and focal length (wide angle to tele) must be properly understood, in order to mitigate motion blur – regardless of shutter speed.

When shooting a photo at a wide angle (e.g. 20mm focal length), at a shutter speed of 1/100s, it is unlikely to cause much motion blur when shooting with a steady hand. Doing the same with a focal length of 500mm (extreme tele lens with high power of magnification), it is almost impossible to get a decent shot under the same conditions – leading to too much motion blur, and a photo that may yield little practical value.

Remember that whenever you use tele lenses or zoom lenses in the tele-range, your shutter speeds must be set to faster, to mitigate motion blur. When working in manual shutter speed mode, this is easy to do – but sometimes difficult to remember!

Viewfinder and focusing

Viewfinders come in different layouts, and with different numbers of auto-focus points and auto-focus zones. These points or zones can be selected, and they tell the camera that it is in this area, or that specific point, where the focus of the photo should be. Focusing is achieved in most cameras by slightly depressing the shutter release; the focus area (or point) lights up, and generally, when focus is achieved, a beep or similar is emitted by the camera. The photo can then be shot by pressing the shutter release all the way down.

A good option is to set the camera on zonal focusing mode and choose the central part of the viewfinder as the zone on which the camera should focus. Manual focusing ought to be used only in situations where the camera has difficulty to auto-focus in low light and low contrast conditions – e.g. in very foggy early morning conditions.

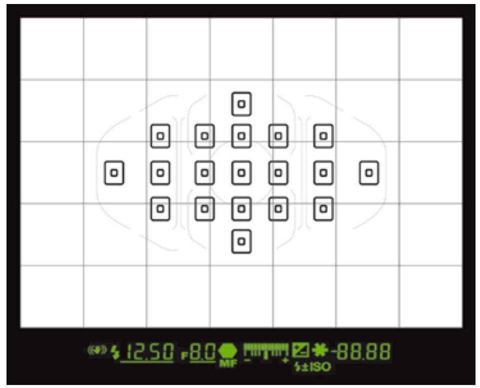


Figure 8. Viewfinder, showing auto-focus points and auto-focus fields that can be selected, and a selection of camera settings below the screen © Trygg Mat Tracking

Framing

Framing refers to setting the object within the frame of the photograph. The all-important part is that all elements that we want to cover in a single shot appear in the photo. With a zoom lens this is generally quite straight forward, as we can zoom in and out of the frame until all elements are included.

Maximum detail is obtained with maximum zoom. As an object fills up the frame, more pixels are dedicated to its representation. The more we zoom out of a picture, the less detail we will be able to reveal in photographic analysis. It is therefore important to decide which photographs are needed to show the overall scene (e.g. vessel and the fishing gear in the water alongside), and which photographs are needed to focus on, and zoom into details (e.g. the displayed call sign or drying shark fins strung up on deck).

As a rule of thumb, snap a little bit more within any given frame than what is targeted – to stay on the safe side – but not too much.

Metering

Metering refers to the way in which the camera measures the light in the frame, and how it directs the setting of values set to automatic – as a result of metering. This could be ISO, the aperture value or the shutter speed. These values are set as a function of the amount of light entering the lens – and how the camera "meters" – or measures – the distribution of this light. Inbound light can be distributed and measured in different ways. To deal with this, cameras propose different metering modes.

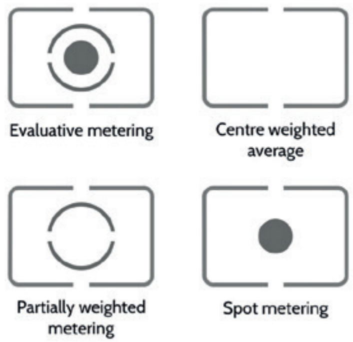


Figure 9. Standard set of metering modes that can be selected on a modern DSLR 15

For the purposes of air patrol photography, "centre weighted" metering is a good choice, with the average more biased towards the centre of the scene. It must be used in combination with center-of-the frame focusing and central framing of the object of interest. In this way, you ensure that the light emitted by the subject determines the shot, ensuring the subject is optimally exposed. In all other cases, including moments of high turbulence, it is safe to opt for evaluative metering instead.

Shutter release and shooting photos

Pressing the release button snaps a photo. Assuming that a large and fast storage medium is given, it is generally good practice to set the camera to multiple-shot mode (also called "continuous" or "burst" mode).

If the shutter is pressed for a short period, the camera will snap a single picture. If the shutter button is pressed a little longer, the camera will snap a series of pictures.

Burst mode is especially useful in rocky situations, where the aircraft might be hitting much turbulence, and the fishing vessel might be pitching and yawing a lot in heavy waters. Under these conditions, photos tend to become blurred. In series of shots snapped in fast sequence – and from a steady hand – single photos within a given series tend to come out better than others. Some may even come out sharp under dismal conditions. Beating the odds is achieved by operating the photo camera as if it were a machine gun.

Customized pre-programmed camera settings

High-end DSLRs often come with a number of blank setting slots that can be defined by the user. These settings can be activated by a flick of the mode dial.

These presets can be customized for given situations, or specific lenses. This means that the white balance, the ISO, the shutter of aperture mode, the shutter speed (Tv) or aperture value (Av), and many other settings can be defined and recorded under a given pre-set. This allows the photographer, when changing a lens, or when hitting turbulence, to implement the appropriate settings be done by the flick of a switch in under one second. The need to start fiddling around with the camera to select new settings – and this can be time consuming, including the risk of getting it wrong – potentially resulting in frustrating mission photo results, can be effectively mitigated this way.

Figure 10. Small display next to shutter release, showing a summary of camera settings, including the "high-speed" (H) burst mode showing in the bottom right corner of the display © Gilles Hosch/Trygg Mat Tracking

Figure 11. Mode dial, set on shutter priority mode (Tv), showing three custom pre-set slots (C1, C2 & C3) that the photographer can dial into © Gilles Hosch/Trygg Mat Tracking

GPS interface

High-end DSLRs are generally equipped with an internal GPS sensor. If the photo is to be tagged with geographic coordinates in its metadata – the default good practice standard – then the GPS function must be switched on. Note that this should be done before entering the aircraft, as it may be difficult for the camera GPS to locate a satellite signal once you are inside. Keep an eye on the GPS indicator; if during flight the signal is lost, it may be necessary to label photos when they are stored later with the positional information from the aircraft itself.

Note that the GPS feature of a camera renders the location of the camera, as opposed to the "target". The forward-looking infrared camera (FLIR) which can be fitted to a patrol aircraft generally provides the geo-location of the "target".

Figure 12. Camera display at the back of the camera, showing the various menu selections to adjust wider camera settings, such as date, time and GPS mode © Gilles Hosch/Trygg Mat Tracking

Time and date settings

The very first thing to set on a camera that comes into the custody of an inspector is to verify the date and time setting on the camera, and to adjust it in case it is wrong. These data will be embedded in the metadata of every photograph and must be right for photos taken in the domain of law enforcement work.

Embedding of GPS/TIME Stamp

GPS (when enabled) and date/time data are automatically recorded into a photograph's metadata. The metadata are part and parcel of a photographs' overall dataset and can be embedded into the photo at the time of processing the images for release. The stamp is not hardwired into the photograph itself – in the sense of physically replacing photo pixels within the photograph – and can be added to any spot of choice within the photograph during post-processing.

The metadata, including time of day, date and geo-location, should not and cannot be modified.

Figure 13. In the image of the two longliners (left), the name of the vessel on the left cannot be read. However, high resolution photos allow room to zoom in, and in the second photo (above) the name of the vessel can be clearly identified. ©Trygg Mat Tracking

Photographer's training

This section only covers the bare essentials you need to understand your camera, and to start taking photographs in an informed and confident manner. However, taking high quality photos in a consistent and confident manner during air patrols – with many unknowns and in fluid high-stress situations – is a skill that can only be developed through ample hands-on practice.

Camera handling, trying out different types of settings, snapping test shots, memorizing where given settings and menus can be accessed and modified on the camera, practicing drills such as switching lenses, etc. – all of these can and should be practiced at home or at the office. Ample practical training will allow an inspector to develop the necessary skills, and to become an able and competent photographer.

1.3 Post-processing – hunting for detail

"Post-processing" refers to the act of working with a photograph after it has been shot. In forensics, it refers to the actions you may need to perform on a photo file in order to tease out elements of information that you cannot see without amplifying and/or enhancing the picture in a number of different ways.

What is important to appreciate is that this work primarily serves the purpose of identifying as many elements of interest as possible, rather than "creating" more or new evidence. Photos enhanced through post-processing and presented as evidence in a court of law would likely be given a hard time at the hands of a capable defence lawyer in most jurisdictions.

Various electronic picture formats

Following copying of the original photo files in RAW format from the camera's storage medium and saving them onto a separate medium – e.g. the inspector's computer hard-drive – the format of the copied photo files may need conversion. RAW files are very large and often uncomfortably slow to work with. Following download, the inspector may thus wish to convert them into one of the many less bulkier formats, such as TIFF and JPEG, before starting to analyze them.

These file types can be easily processed using a standard photo editing software package.

Zooming in

The photo detail a recent full-frame DSLR fitted with a high-quality lens and photo sensor can shoot at low ISO, a middle of the range aperture and a very fast shutter speed, can be truly overwhelming.

The detail can often not be made out at 1:1 resolution with the naked eye. Zooming in into particular areas of interest allows to see detail that is otherwise too small to be made out. This particular action does not modify or alter the photo. It is merely a crutch to assist the human eye to make out the detail actually embedded in the photo.

Standard software packages allow zooming in, crop and save details of larger photos as separate files.

In the shadows, out of the shadows

In the presence of bright light especially, shadows tend to be very dark, and the human eye can see little therein. For modern photo sensors, the blinding effect of the surrounding much brighter light is less, and more detail than is apparent to the human eye is captured by the photo in the shadow areas of photographs also. These details can be "brought to light" by tweaking the photo – and essentially increasing the contrast of objects detected in shadow areas. By doing so, these objects then start to take on much clearer outlines and forms.

In this manipulation, it is sometimes possible to identify things of which the photographer was unaware during the air patrol and the photo shoot. It is therefore good practice to subject photos with important shadow areas – with the potential to reveal new elements – to a post-processing routine in which the veil of shadows is electronically lifted as far as possible.

Softness and contrast

Photos can present a lot of 'softness' under low and diffuse light conditions – essentially a lack of contrast. This entails softer shadows, where the difference between bright and dark surfaces is low across the photo, and distinct objects have the tendency to merge. Air humidity can also increase softness. In some corners of interest, we can expect softness under regular light conditions; the latter pertains for instance to vessel names embossed in the hull and painted over. Since the same (often white) colour covers the flat and embossed parts of the underlying hull, it is often not possible to make out the letters, because of softness – or lack of contrast.

However, contrast can be added to pictures using standard photo editing software, and ramped up the max in order to reveal patterns and structures underneath paint jobs – or to better visualize the distinguishing features of a vessel shot from afar under poor light conditions.

Figure 14. In the top photo, the image shows the name painted on the stern of the vessel. However once zoomed in and the softness in the photo is eliminated, other identifiers of the vessel are revealed. ©Trygg Mat Tracking

Blur and sharpness

Photos can present blur, due to wrong focus or too much motion during the shutter release process. In either case, re-focusing the photo is not possible with a DSLR camera.[1] In some instances it is of interest to sharpen the photo in post-processing, as there may be elements on deck for instance, that we want to be able to count, or that we want to get a more precise idea about (shape).

Standard photo processing software packages contain a sharpening function, where the software processes blur, and eliminates as much of it as possible. After sharpening a photo, you may become able to count a set of flagged buoys held on deck, for instance, while it may not be possible to do so on the unadulterated original photo.

[1] Adjusting the focus point and depth of field after a photo has been taken is possible with a light-field camera, while motion blur cannot be eliminated with such cameras either.

2 Air Patrol Photography

Figure 17. © Pacific Islands Fisheries Forum Agency

2.1 Aircraft types and implications for photography

Fixed wing

This manual is written from the perspective of using a fixed wing aircraft for air patrols. With regards to photography, the most important element on the aircraft is the window through which the photographer shoots. The photographer is generally limited to shooting laterally out of the plane – i.e. she/he cannot look ahead like the pilot does. This limited field of vision entails a series of complications addressed below.

If the aircraft can operate with an open window or door, through which photos can be shot, many of the challenges of shooting from an aircraft are solved.

In all other cases – and these are the norm – a bubble-type window is the next best set-up, as it enables the photographer to shoot from a wider range of angles. The photographer is a little bit less constrained by the aircraft's position relative to the fishing vessel when a bubble-type window is fitted.

Helicopters

Helicopters are sometimes used for air patrol work. For the photographer, everything is easy on a helicopter. The helicopter can hover – cutting out motion, it can fly alongside a vessel at the same speed, the door can be opened, and photos can be shot without having to shoot through a window.

Helicopter © Pacific Islands Fisheries Forum Agency

Shooting through an aircraft window

Scratches:
Even if you only have two windows to choose from, choose the window that has the least amount of scratches on it. Scratches can distract the auto-focusing mode of the camera, having the camera focusing on the window, rather than the object of enquiry. In any situation where this becomes a problem, you must switch to manual focusing straight away.

Cleanliness:
Bring window cleaner and wipes, so that the window(s) used to shoot from can be cleaned, so as to be free of dust and smears. Dirty windows diminish the overall quality of photos. Like scratches, they also tend to interfere with the cameras' auto-focus mode. Make sure the outside surface of the window is clean also – before take-off!

Reflections:
Reflections in the window arise from inside the cabin and are generated by brightly lit objects and can seriously impair the quality of photos. Hence, all windows not in use should be shut to dim the cabin. All cabin lights should be turned off. The photographer and anybody next to her/him should be wearing a black – or very dark – shirt. If there is too much light in the cabin, generating a lot of reflection, a black curtain should be hung around the window and the seat of the photographer – so that light sources from within the cabin can be cut out, leaving the photographer and her/his camera in a makeshift black chamber. The lens hood should be fitted to the lens, and the hood should get as close as to the window as possible when shooting, but without touching it.

2.2 Mission preparation checklist

Every photographer needs to have her or his checklist, and to go through it meticulously the day before the mission. The checklist serves to ensure that all gear is "on board", and that all gear on board is fully loaded, functional, and ready to operate. The checklist and its consistent implementation provide the guarantee that the photography part of the patrol mission will be executed successfully – every single time a mission is flown. The checklist should be implemented within the 24 hours preceding the planned air patrol mission – at a time when any faulty equipment may still be replaced.

Inspectors should customize their own checklist, as these are always conditioned to some degree by the exact type of photo equipment and aircraft used. However, the basic elements are listed below.

Photo Checklist

1. **Aircraft cabin photo gear:** Window cleaner and wipes, black cloak, duct tape (as appropriate). Check you are wearing a dark shirt – or have a dark shirt with you.
2. **Main Camera:** Switch on, check battery status is full. Fire test shot. Check the result. Delete test shots and ensure the storage medium is empty. If it is not empty, download the remaining photographs – if any – and then empty the card. Ensure date/time is correct. Ensure GPS functionality is on and signal located.
3. **Back-up camera body:** Attach a lens, then apply the same routine as for the main camera.
4. **Back-up batteries:** Two. Check load status is full.
5. **Back-up storage media:** Two 64 or 128Gb SD- of CF-type cards. Insert into the main camera, check they are working by firing a test shot, view photo, delete, and ensure storage media are both empty.
6. **Lenses:** Check the selection of lenses (wide to tele) is packed. Individually remove lens cap, check presence and cleanliness of filter, check presence of a hood for each lens. Attach each individual lens to the camera and fire a test shot – ensuring the lens works correctly. Delete test shot(s) when done.
7. **Photo bag:** Final overall check to make sure all the tested equipment (camera bodies, lenses, spare batteries, and storage media) are in place. The bag may also contain further useful items, such as lens wipes and cleansing liquid, spare filters, this manual, etc. Once satisfied that all is there, zip the bag shut, and make sure nobody touches it until you take it onboard. Check the contents one final time, just before boarding the aircraft. Better be safe than sorry!

© Francisco Blaha

2.3 Air patrol – preparing & communicating effectively

Mission plan

An Air Task Order and a flight plan, raised via FFA/PMSP Aerial Surveillance SOPs", will stand 12 hours before the patrol mission is launched, at the latest, and contains the detail of the mission's objectives. It is of essence for the photographer to discuss the order and the patrol plan it includes with the lead inspector. The objective of this discussion is to determine the tasks of the photographer, and to make sure everybody has a full understanding of what this part of the work implies and requires. This discussion is a natural part of the brief that is normally held ahead of the patrol with all patrol party members present.

The pilot, the lead inspector and the photographer

It is understood that the lead inspector on board of the aircraft assumes operational mission control. In the case where this person is also the photographer, things are straightforward. The photographer communicates directly with the pilot at given points in time during the patrol to indicate what manoeuvres are to be flown by the pilot in order to shoot a particular target.

If the photographer is not the party lead, a good option is for the lead to let the photographer take over for the time of the photo shoot, so as to guide the pilot effectively and directly.

If the pilot is unfamiliar with the standard vessel approach(es) (see below), she/he will have to be briefed by the photographer. This shall also be covered in the pre-patrol brief.

2.4 Vessel approach – sequencing the shoot

Why to sequence an approach?

There are several different elements that need to be captured when shooting a fishing vessel from the air. These elements can also vary between vessel types (fishing vessel types, reefers, bunker vessels, etc.) and also between particular situations (sailing, fishing, transhipping, etc.). The vessel type and the situation determine what needs to be captured, which in turn determines how you should approach and cover the scene.

It is useful to think of those elements pertaining to vessel type and situation as the shopping list and taking that to the supermarket. Generally speaking, people who do the family shopping write down their shopping list in the way they will walk through the market. This cuts time and effort. The person can walk from section to section – without turning back – and getting everything required in the smallest amount of time. This is the same in aerial photography. Also, since a vessel may be shot during illegal activity, time is of the essence, and the pictures should be snapped as soon and as comprehensively following the making of visual contact with the vessel.

A specific pattern of fly-bys will guarantee that all the required bases are covered in minimum time. A sequence can always be modified in-real-time as a function of emerging needs. It merely serves the purpose to fly the pre-agreed pattern with both pilot and photographer able to focus on their individual tasks with minimum communication needs.

How to sequence an approach?

Vessels will invariably be approached from a distance and will initially not be disturbed by the presence of an aircraft cruising at higher altitude in the distance. It is recommended therefore to first photograph the general situation by snapping the scene from a distance at cruising altitude, using the tele lens.

During this part, it is important to assess the position of the light source (sun), and to align the aircraft with the latter, so that the approach may be flown with the light at the back of the aircraft. With the light anywhere in the 180° behind the photographer's line of sight is good, while the more directly behind, the better it is. Generally, once a vessel is spotted, and there is no other situational element requiring a different decision (including air safety ones), the approach should be lined up according to this criterion.

During the approach, the vessel slowly starts to fill up the frame and more situational photos are shot. Once the plane gets close to the vessel, it will drop in altitude, and stage a number of short-range fly-bys. During this final approach and descent, the inspector switches to the wide angle zoom lens. The fly-bys then serve the purpose of covering all the details of interest pertaining to the vessel itself (activity on deck, vessel characteristics, markings, fishing gear, hatches, shoots and windows, superstructure, winches, etc.), and possibly some situational matter in the direct vicinity of the vessel (e.g. blue boats anchored on outer reefs may have divers in the water, etc.).

The various phases of an approach - covering all bases

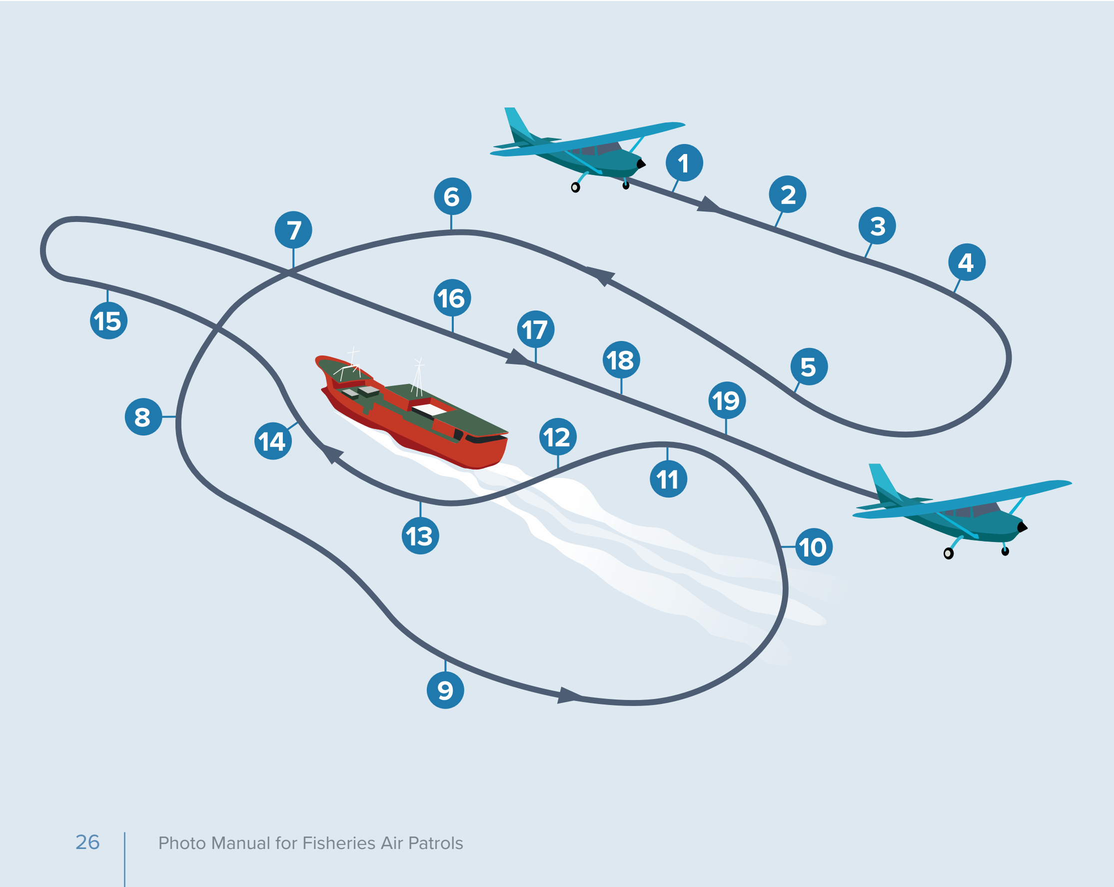
Every photo-inspector may start working with the standardized approach sequence shown in the figure 18 and may want to refine and further develop her/his own sequence(s) on the basis of her/his experience. These must invariably be shared and discussed with the pilot during mission briefings to ensure effective communication.

The diagram shows a standardized approach of an aircraft to a vessel. The proposed sequencing falls into four discrete phases, as follows:

A. the initial approach;
B. the birds-eye lateral bank fly-over;
C. the lateral low-level fly-by from the stern;
D. the lateral low-level opposite side fly-by from the bow.

The different sequences of the approach are numbered and described here to the right.

Figure 18. Standardized approach and fly-bys of a patrol aircraft
Source: Adapted from 'Oil pollution at sea, Securing evidence on discharges from ships'. Manual, Bonn Agreement, 1993



Phase	Sequence	Action
A	1	A vessel is spotted. The lead inspector decides whether to fly an approach or not.
	2	Photographer assesses the situation and proposes an initial approach path and the sequence to follow to the pilot. The photographer readies her/his camera.
	3	Start shooting situational photos with tele lens during initial approach – once the vessel(s) and any related particulars start filling up the frame to at least 25%. Check these first photos for quality.
B	4	On getting closer to the vessel, the aircraft descends to some 600 feet
	5 - 10	Vessel fly-over with lateral bank, circling the vessel over the bow. The photographer covers the vessel from a birds-eye view, allowing her/him to shoot all details on deck, providing a close to 360° coverage – still using the tele lens.
C	11	Descent to 200 feet for low and close fly-by. Switching lenses to wide-angle zoom lens.
	12-14	Shooting of lateral vessel features (port), including stern, superstructure and bow markings.
	15	The photographer has a quick run through last photos to check results.
D	16-18	Shooting of lateral vessel features (starboard), including wheelhouse and all features and markings – including those on bow.
	19	Decision whether any phase needs to be flown again. If not, aircraft ascends to cruising altitude and continues mission.

Checking the first shot!

Checking the first shot serves the purpose to verify the photographic result under the current camera settings, making sure the desired photo quality is achieved. This pertains specifically – albeit not exclusively – to the selected metering mode and the shutter speed. If the first shot presents weaknesses (e.g. too much motion blur), the settings need to be adjusted as a function of whatever the issue seems to be. In case of excessive motion blur, the shutter speed would have to be ramped up, for instance.

2.5 Shooting in motion – special skills

Fishing vessel motion

Pitch, roll, yaw, sway and heave are the five components of vessel motion in water. If vessels are shot in heavier seas, these movement components kick in, movement is important, and the risk for excessive motion blur in resulting photos increases.

A good photographer gauges the importance and rhythmicity of these components, in order to time her/his shots in a way that the vessel can be frozen in motion. The moments where vessel motion is minimal occur at those points in time when any motion component reaches its dead point between its bi-directional swing – and more so when a number of components are swinging together (i.e. a pitch a roll and a heave might reach a dead point around the same point in time). While pictures can be shot continually at any stage, the photographer should ensure that those dead-point moments are part of the sequence fired.

Figure 19. Fishing vessel in very heavy seas (Royal Air Force search and rescue Sea King helicopter comes to the aid of French fishing vessel Alf (LS683637) during a storm in the Irish Sea; March 2013)

Motion of the aircraft

Aircraft may themselves be the object of turbulence, inflicting motion on the cabin, the photographer, her/his hand, and the camera. Such turbulence is difficult to anticipate and cannot be forecast and mitigated in the same way as fishing vessel motion discussed above. The most appropriate way to mitigate turbulence is to keep the camera cupped and sitting in the left hand, and to absorb turbulence shocks by actively counterbalancing such movements with the left arm.

Moving the camera to keep the subject in focus

The other important component of motion is that of the aircraft flying up and down the side of the fishing vessel during phases C and D. Circling the vessel at a higher altitude – phase B – limits the impact of this specific motion.

During these particular sequences, the photographer focuses on a specific object of interest, and then keeps her/his aim and the focal point/zone trained on that same spot, moving the hand laterally towards the back of the plane as the plane executes its fly-by – compensating for the movement of the plane. Once a sequence is shot, she/he swings back forward, selects the next object of interest, and repeats the motion and releases the shutter again – in a see-sawing "up/down, up/down, up/down..." manner.

Camera settings

The more significant the vessel movements, or aircraft turbulence, the faster the shutter speed must be set. In bad weather and poor light conditions, often coinciding with turbulence and heavy seas, this goes hand in hand with the need for a larger aperture and a higher ISO setting – to compensate for the loss in light owing to the faster shutter speed.

In very bad and high motion situations, shutter speeds might have to go up to 1/1000 sec and beyond in order to be able to shoot usable material.

2.6 Photographic evidence – logs and records

The RAW file & metadata

Every photo is saved as a single RAW file on the storage medium by the camera. The file contains the photo, the GPS data, and the time and date data (amongst many others). These metadata cannot be altered and are the cornerstones of the evidence collected during the air patrol. It is essential to protect the storage medium until the end of the air patrol mission, avoiding any manipulation of the storage's interface on the camera altogether.

Storage and copies

A routine and set of rules must establish onto which/whose PC – or other external medium (e.g. an external hard drive or cloud storage) – the photos are to be copied following air patrols. If infringements have been detected at sea, and photographic evidence has been collected, the correct and documented handling of the original storage medium becomes critical – as it contains the prima facie evidence which will serve to convict offenders.

Therefore, the original storage medium should have its contents copied upon return and should then not be the object of any further manipulation – and be kept in a safe and secure place.

The formal photo log

Using the copied photos, the photographer then raises a photo log, which is a detailed account of all the photos shot during the mission. An example of a photo log is found in Annex I to this manual.

It is possible for an air patrol mission to shoot several thousand photos. The photo log serves the purpose of being able to quickly dial to and into a series of photographs that are of interest. The log also establishes an administrative-type document providing information as to when and by whom a specific vessel was directly observed at sea.

Safe-keeping of evidence – and evidence thereof

In general terms, the storage medium should be kept in a safe place, clearly labelled, with restricted and known access until all photos have been formally analysed. Given the number of pictures to assess, this can take days or weeks. If the storage medium is removed from storage during any moment over this period, this should be recorded in a formal log - recording details of the movements, together with the reason why the medium is moved, and by whom. This log serves as evidence that the medium and the photographs it contains were protected from any potential tampering with evidence.

If no infringements are detected upon analysis of all photographs shot during an air patrol, the original storage medium may be released for re-usage in a future air mission. However, if the budget is not limiting, the original storage medium may as well be kept in storage for a given number of years.

If infringements are detected, the storage medium should immediately be physically labelled with the air patrol code, and kept in storage in unadulterated form until the end of all judicial proceedings – or alternatively – until all administrative fines have been issued and settled.

3 Fishing vessel identification

3.1 Shooting for what?

During an air patrol, two types of vessels are going to surface. The first type encompasses those vessels that are known to be operating in the zone, that are licensed to operate, and that are broadcasting their identity and position. The other type are those unknown to be there, that are not broadcasting their identity and position, and/or that also may not hold a valid authorisation to operate in the zone. It is assumed that inspectors aboard the aircraft will have the most recent vessel authorization list and corresponding positions of all legally operating vessels in the mission patrol area.

If the decision is taken to shoot a legally operating vessel in the zone, the focus for the photographer will be on operational details. This includes, but is not limited to activity on deck, fish or fish products on deck, gear in the water, specific manoeuvres being carried out, etc. – elements which could reveal any type of illegal activity being carried out. During these shoots, phase B (higher altitude lateral bank and fly-by) is more important, and the photographer may want to repeat this sequence, so that as many details as possible may be shot from above.

If an unknown vessel is detected and becomes a designated target, then the first priority will be on photos allowing vessel identification, and secondary on detailed activity on deck – which in the case of illegal fishing vessels may have been actively suppressed and/or ceased by the time the higher altitude fly-by is executed. Here, the accent will be on phases C and D of the phased approach and shooting sequence, and the photographer's focus will be on shooting as many details of the vessel's features as practically possible. This process should also be followed for a legally authorized vessel that is detected that may be conducting another form of illegal activity, such as un-authorised transhipment.

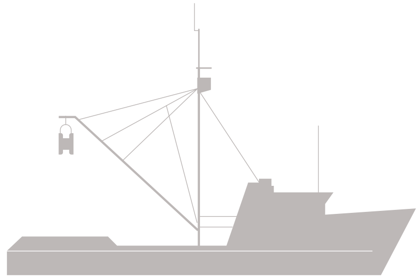
3.2 Vessel types and outlines

The fisheries inspector should have a clear knowledge and understanding of the types of fishing vessels that are operating in the seas around her/him, and the waters that are going to be covered by the air patrol. In the FFA area, these vessels are largely limited to four basic fishing vessel types (activity: fishing), and one support vessel type (activity: fish carrier) – also referred to as "fishing vessels" under most legal frameworks.

General outlines and basic visual characteristics of these vessels are presented on pages 31 to 33.

Purse seiners

Figure 20

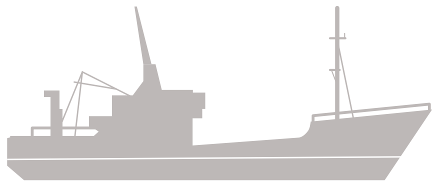


© Pacific Islands Fisheries Forum Agency

- Large vessels (WCPFC av. 69m LOA)
- Sleek hull – almost always made of steel
- Very distinctive crows nest
- Very large winch toward the aft
- Sloping stern
- Purse seine net openly stored aft
- Sometimes have a helipad
- Wheelhouse generally towards the bow

Longliners

Figure 21

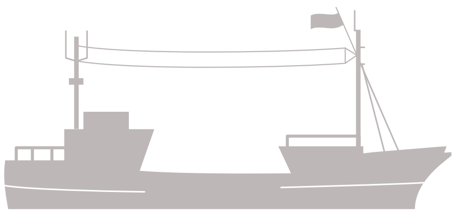


©Trygg Mat Tracking

- Medium-sized vessels (WCPFC av. 31m LOA)
- Stockier hull
- Wheelhouse in mid- to aft section of hull
- Wheelhouse often integrated into hull, limiting obvious super-structure
- Few cranes, turrets – if any
- Straight stern
- Flagged and brightly coloured buoys on deck when gear out of the water
- Generally, a lower kept fore- to mid-hull section where lines are hauled in – often with a side-cut on starboard side of vessels

Pole and line vessels

Figure 22

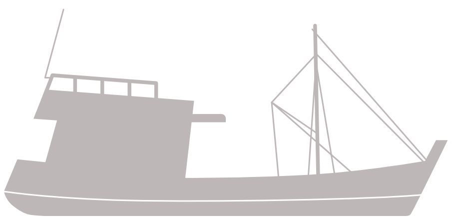


© Francisco Blaha

- Medium-sized vessels (WCPFC av. 35m LOA)
- Hull made of wood, fiberglass, or steel
- Position of wheelhouse can vary
- Always have a large open deck to fore or aft
- Can have crane and crows nest
- Generally, with arrays of hatches in deck

Blue boats

Figure 23

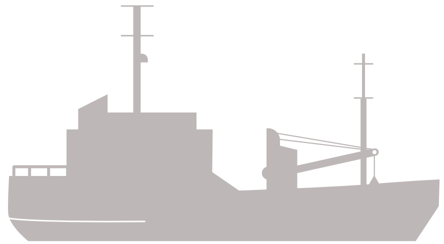


© Pacific Islands Fisheries Forum Agency

- Hull often made of wood
- Vessels generally no longer than 30m LOA
- Wheelhouse almost always toward the aft
- Hull often curve-shaped with bow and stern sloping upwards, with a lower mid-section
- Generally, a large and extended gear storage area on top of the wheelhouse

Reefers (fish carriers)

Figure 24

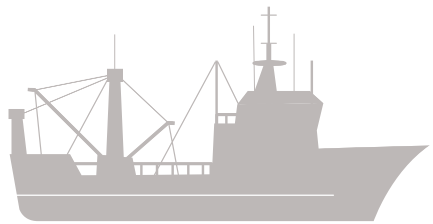


©Francisco Blaha

- Large steel-hulled vessels
- Superstructure generally towards the stern
- Generally, with a couple of large cranes across the mid-section of the deck
- Generally, with arrays of large hatches in large, unencumbered and open deck
- Large fenders often seen hanging from the sides

Trawlers

Figure 25



©Trygg Mat Tracking

- Steel hulled, can vary in size from small (<10m) to very large vessels
- Superstructure generally mid to forward in hull
- Drag funnel-shaped trawl nets through the water to catch fish or shellfish. Frequently structures at the stern of the vessel to support deployment of gear
- Two types: 1. Bottom/Benthic Trawlers, designed to drag the trawl nets either just above or along the seafloor;
- and 2. Midwater/Pelagic Trawlers fish within the water column targeting schooling pelagic fish

(both types shown in image)

3.3 Vessel features assisting in identification

Identifying basic fishing vessel types is generally quite straightforward. However, identifying individual vessels amongst thousands of similar-featured vessels, when identification marks cannot be made out or are obscured – or when displayed identification marks do not match with an officially registered fishing vessel – and when the vessel is not broadcasting its identity (AIS/VMS), then focus on photo detail is one of the very few avenues to confidently identifying a vessel.

It is therefore of absolute importance for the photographer to know whether a vessel is known and identified before it is photographed, focusing on activity and situational bigger picture, or whether she/her is shooting photos that will primarily serve the purpose of identifying the vessel.

> It is highly recommended that the Chapter titled 'Photos of Fishing Vessels, What to look for' in the *Photo Manual for Fisheries Enforcement* is reviewed alongside this section of the manual.

Vessel size

Vessel size is an important element in nailing down a vessel's identity – and speeds up research. There is an (uncomfortable) way to measure vessel size using the camera. For cameras that do report focusing distance (alongside focal length) in the metadata, it is possible to develop lens specific reference curves to estimate vessel size. This is best done with a shorter focal length (e.g. 35mm) shooting from closer range and filling up the frame to a large degree, so that the focal distance is limited – minimizing camera estimation error.

For this to work, vessels must be shot laterally at a 90° angle (exactly from the side), at any height from straight above down to the sea surface. The ratio of the vessel LOA to the photo's width can then be computed, and run against the curve, yielding a LOA estimate.

If the inspector can confidently estimate a longliner to fall into the 20-25m LOA range, as an example, potential matches on the WCPFC RAV drop from 1703 down to 519 – eliminating 69.5% of potential candidates. The same dynamic applies to all other records to be queried.

Colour

Vessel colour is one of the features that can change regularly in vessels with a shady background. However, capturing the colour properly on a photo will require shooting with the light in the back, and to have the right white balance selected.

Hull

The shape of the hull is a vessel feature that is not easily modified. It should be shot from all angles, providing outlines of the bow and the stern's profile, the full profile of the vessel laterally, and including a good shot from the top. The latter bird's eye view allows to estimate the length/width ratio of the vessel; combined with a length estimate, this also allows to estimate vessel width.

Vessel markings

The vessel markings are crucial. They encompass the vessel name, home port, the vessel registration number, the international radio call sign, and the IMO number, plus any additional markings that can be made out.

When shooting individual markings, always try to fire a series of shots that isolate them as much as possible within the frame. Be on the look-out for embossed or otherwise painted former markings, that may have been painted over. These can be revealed in post-processing.

Flag

Though obvious, the flag is sometimes forgotten. It indicates the country of registration of the vessel, offering a primary stop to start any investigation into a vessel.

Superstructure and wheelhouse

The superstructure and wheelhouse are super-important features, both within the overall picture of the vessel, as well as with regards to their specific features (windows, railings, staircases, antennas, exhaust pipes, etc.).

When shooting in approach phases C & D, take great care in singling out the superstructure and the wheelhouse, and in obtaining good shots from the bow, the stern and port and starboard sides.

Openings: windows, shoots, and hatches

Windows, shoots, and other openings (e.g. drainage cuts) are vertically arranged, while hatches are facing upwards mostly. These are distinctive features of a vessel, they are cut into the hull, and they rarely change. Photos should be good enough to make a full inventory of all the distinctive openings in a hull, and these are some of the most important elements in confidently identifying a vessel. Shoots, through which processing offal, waste and/or other goodies are evacuated into the sea are often easy to spot – also when closed – because of the vertical rust marks often extending down from these to the waterline.

Exhaust pipes

The smokestack(s) of a vessel are another feature that ought to be shot with great care. They vary immensely between vessels and are thus a highly distinctive feature.

Crows nest

Both purse seiners and pole and line vessels can come fitted with a crows nest – or a look out platform. Purse seiners generally have them, while some pole & line vessels do, and others do not. These are also highly distinctive and vary much between vessels, implying that they should be shot with great care.

Company logos

Some vessels display company logos – often on the smokestack, sometimes on the wheelhouse, bow, etc. This is another distinctive feature that must be captured if present. Be on the look-out for embossed company logos that may have been painted over also.

Fishing gear and related elements

Fishing gear will vary from country to country, and from fishing culture to fishing culture. Whenever gear can be photographed onboard a vessel, or in the water, this should be done. As well as potential evidence of wrongdoing, the resulting photos may also harbour clues as to the likely nationality or broader origin of the operators.

3.4 Researching unidentifiable vessels

Following the end of the air patrol, the photo-inspector returns to her/his desk. Photography-related forensic work starts here.

Poor photos lead to lots of extra work. Photos presented under the case study of the Panofi Discoverer below provide pertinent examples of photos suffering from excessive blur, glare and under-exposure, leading to a situation where the vessel could not be identified directly from photos.

It is hence opportune to remind the photographer at this point in the manual that the honing of your photography skills is essential if lots of extra time on land is to be avoided, and so that chances to identify vessels are maximized.

Vessels can be unidentifiable in photos for two main reasons: a) the photos are of such poor quality that markings nor very much else can be made out from the images, or b) the photos are good, but the vessel is either not marked at all, was not broadcasting a valid identity, and/or bears markings (and an identity) unknown to any authority in whose waters it was observed operating.

All other (and otherwise duly registered and licensed) vessels are found in national and/or regional records of authorized vessels (RAVs), and this straightforward identification is not further discussed.

Note the post-processing techniques under section 1.3, that may help reveal additional elements – such as past vessel names – not visible to the naked eye without electronic enhancement of the photo.

Figure 26. This is a bad photo! It is the result of blur from an out of focus lens, glare from being shot directly into the sun, and is under exposed. As a result no vessel identifiers are visible, and the photo is not useable. ©Trygg Mat Tracking

Figure 27. This is a good photo! The target vessels are clear and in focus, there is limited glare, and both vessel identifiers and activity are clearly captured. ©Trygg Mat Tracking

Poor photo quality

When photos are bad, there is usually still some degree of detail that can be made out. One of the real-life examples that follows – that of the purse seiner Panofi Discoverer observed fishing illegally in the Liberian EEZ in 2012 – shows how some of the blurred details may still be sufficient to confidently identify a vessel.

Obviously, identifying a vessel based on very poor photos is conditioned by the fact that the vessel is formally and duly registered and licensed, implying that a formal trace of this vessel exists in official records. In the absence of this, records of known IUU fishing vessels may be researched, but the chances of identifying such vessels is more limited and tends towards nil the smaller vessels get.

Large, industrial-scale “off-radar” illegal vessels may still be identified on the basis of their history of prior sightings and photos on record, but relatively few such vessels exist. This is becoming increasingly more difficult with smaller vessels, of which many thousand lookalike units may exist, and may be operating throughout a region.

The sequence to follow for the purpose of vessel identification can be the following:

Vessel type:

The inspector can establish the vessel type – also in the absence of the photo – based on the sighting and air patrol record.

Vessel features:

How many and which features does the photo yield? Are there any particular features that can be made out/guessed, and that appear to be uncommon or unique? This can relate to colour, flag (or its colours), smokestacks, the position of the wheelhouse, masts and cranes, the estimated size (!) or shape of the hull, major portside/starboard side differences, etc.

Vessel markings:

Are any of the markings visible to some degree, and providing any info? Number of digits/letters? Type of script (e.g. Asian/Alphabet - mixed)? Vessel name – one word or several words? Numbers? Same for home port – one word or several words?

A log of all of the distinctive features that can be made out should be raised, and then the inspector can be tasked with researching records, looking for those particular features.

Research stops

A first stop is to overlay the flight path with the VMS and available AIS maps (especially the latter), which may reveal the presence of vessels that were snapped and could not be identified during the approach and shoot.

As the next step, a vast number of online resources exist to research fishing vessels with given characteristics – many of which also provide photos of vessels on record. The latter is obviously of critical importance to assert the identity of a vessel of which we have little more than a photo, and with markings not appearing in an official record.

Once relevant official records (WCPFC & coastal States) have been trawled and yielded no results, various records can be reviewed. A cross section of these are provided in Annex 2.

Always share your photos of hard-to-identify vessels with your colleagues and network, asking for their help. The more widely you share, the more likely you are to get a hit.

3.5 Assessing the legality of operations of duly licensed vessels

Finally, this manual would be incomplete if it suggested that aerial photography is limited to identifying IUU vessels. While that might well be the mother of air patrol challenges, all otherwise legal operations subject to an aerial photo shoot should be consistently subjected to an inspection by reviewing the photo material the mission yielded.

The formal sequence to be applied could consist of the following:

- Are all external markings in place as per regulations of the RFMO and/or the coastal State? (flag, markings)
- Are there any indications that illegal activity might be occurring? (e.g. drying shark fins on deck; objects tossed overboard; etc.)
- Are there any shadow areas on deck that could benefit from post-processing to reveal what they may conceal? etc.

All photos taken of any vessel, regardless of whether compliance issues are identified or not, should be added to that vessel's file to ensure that an ongoing visual record is maintained.

A formal routine should be developed to subject any aerial patrol photo sequence of vessels operating at sea to the same routine, by vessel type, and to report on findings formally – including formal findings clearing vessels of any detectable offences based on the analysis of collected photographic evidence.

The latter is truly important and should be made a formal and integral component of compliance data and statistics. It is often neglected by agencies.

3.6 Case study

The case study presented here was originally provided in the *'Photo Manual for Fisheries Enforcement'* and is repeated here for its particular relevance to this manual.

The Panofi Discoverer – a lesson in dismal photography and successful identification

In 2012, a purse seiner was detected fishing in the Exclusive Economic Zone of Liberia during a period when no purse seiners were licensed to operate there. All photographs shot from an air patrol aircraft were of extremely poor quality and did not allow to make out the vessel's name, call sign or any other marking.

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However, comparison with photographs of purse seiners known to be operating in the region enabled analysts throughout a mobilized wider network of MCS practitioners to identify the vessel on the basis of the markings showing the name and home port (even though unreadable), and the physical vessel features.

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On the first picture, distinctive features show a crows nest with several floors, detached from the wheelhouse, and with a kind of second wheelhouse attached to its base on the portside.

The wheelhouse shows three windows on the starboard side, and four on the portside. Importantly – and this was the ultimate give-away – the third picture, a cropped part of a larger picture shot with a tele lens, shows the name of the vessel and its home port on the aft portion of the hull, close to the stern. Though these were not readable at maximum enhancement, they showed that the vessel name was composed of two words, of which the second was the longer one. Note in the third picture also the countervailing light, and the important amount of glare, causing the vessel and the parts of interest to come out underexposed (i.e. dark).

Other intelligence indicated that these vessels may have been of Ghanaian origin. Following a verification of the Ghanaian license record, only two purse seiners could be identified having a name composed of two words, of which the second one was longer than the first. Both vessels were operated by the same large company. A visit to the company website instantly yielded a proper photograph of the vessel – fourth and last photo in this series – allowing inspectors to confidently identify it as the perpetrator.

This case yields three important lessons:

1. Lacking photography skills can result in total inability to identify a vessel – which should never happen;
2. Not being able to read a marking does not mean the marking is useless – quite to the opposite;
3. Other intelligence can and must be leveraged whenever available, to point the investigation in the right direction. Networking and sharing of information, and seeking outside help is part of that process.

Annex 1 Sources of intelligence for the identification of fishing vessels

Combined IUU vessel list:

A consolidated RFMO IUU vessel list is operated by TMT, and can be found here: *www.iuu-vessels.org*. It currently contains over 300 vessels and provides a downloadable Excel file, in which a plethora of features and details can be searched. It provides multiple photographs of vessels where available. FFA has an API with the TMT list, integrating into existing data sources. Internally TMT maintains its proprietary fisheries analytical system FACT, integrating information on fishing vessels and operations globally. Requests for assistance, including photo analysis, can be emailed to *info@tm-tracking.org*.

Records of Authorized Vessels (RAVs):

RAVs of other RFMOs can be reviewed in case there are indications that a vessel operating illegally in the WCPFC/FFA area may actually have a valid and legal status in another world region.

IMO Global Integrated Shipping Information System (GISIS):

This database is of interest for larger vessels that are likely endowed with an IMO number. It can be accessed here: *https://gisis.imo.org/Public/SHIPS/Default.aspx*. The database allows searching by IMO number, former and/or current ship name, the flag State, the call sign and the MMSI number. No photographs.

Consolidated list of authorized fishing vessels (CLAV):

This list is operated by the five tuna-RFMOs, and can be found here: *www.tuna-org.org/globaltvr.htm*. This is a primary and powerful resource to research tuna vessels of any type, and also contains reefers authorized to operate in these fisheries. Hits lead to original RFMO RAVs – which may contain multiple photos of the vessel when available.

Global Fishing Watch (GFW):

GFW provides an interface that allows the visualizing of vessel location based on AIS signals and allows for searching for specific vessels on its interface. The site can be accessed here: *https://globalfishingwatch.org*.

Commercial ship information and image sites:

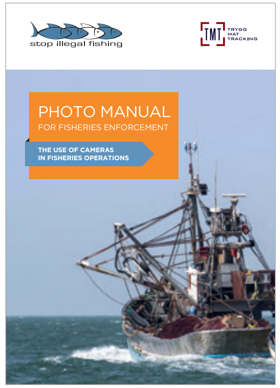
Marine Traffic provides a non-pay interface to search for vessels. It can be accessed here: *www.marinetraffic.com*. It provides a search routine allowing to search according to a range of criteria (MMSI, name, IMO number, etc.), yielding detailed vessel specs and more, a photo and the last known position. Other similarly useful sites include of Vessel Tracker (*www.vesseltracker.com*), Vessel Finder (*www.vesselfinder.com*) and My Ship Tracking (*www.myshiptracking.com*). In addition, www.shipspotting.com is particularly useful for vessel photographs.

Fishing company websites:

Large international fishing companies often host resources on their websites that also comprise photographs of current and past vessels in their fleets.[2] Obviously, these tend to invariably be vessels of large size, but can in some occasions further vessel identification research efforts.

[2] There is no suggestion that these larger companies named as examples here present particular IUU risks.

Annex 2 Photo Manual for Fisheries Enforcement – the use of cameras in fisheries operations



The Photo Manual for Fisheries Air Patrol has been developed in part as companion document to the 'Photo Manual for Fisheries Enforcement – the use of cameras in fisheries operations' previously developed by TMT and Stop Illegal Fishing. It is strongly recommended that both manuals are utilised to strengthen fisheries personnel photographic capacity.

This manual is available in hard copy and also available for download at *https://www.tm-tracking.org/updates-and-resources/categories/manuals-briefings,* and *https://fish-i-network.org/all-publications/*

Annex 3 Photo log

Air patrol record no. or code	
Patrol date	
Camera type	
Storage medium record no. or code	
Photo inspector name	

Description of air patrol

Airport of departure	
Time & date	
Airport of return	
Time & date	
Air patrol narrative (Inspectors on board; area covered; time in the air; no. and types of vessels spotted; time of encounter; no. and types of vessels approached/ photographed; likely no. of IUU events spotted; issues; etc.)	

Log

From photo #	to photo #	Description

From photo #	to photo #	Description